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Summary

During recent years research on the integration of fisheries in MSP has been gaining momentum. We reviewed the state of the art and the progress achieved by more than a dozen studies on ways towards integration of fisheries and MSP along six challenges that may occur in the attempt to integrate fisheries in MSP during the MSP stocktaking and plan development and negotiation phases. It became apparent that tools and methods to identify productive areas with relevance for fish resources, fisheries and the management of fish stocks are widely available or under development. The same is true for models that support analyses on changes in species distribution and of effects of MSP or human uses on existing fisheries. However, very often these tools, methods and models are still in a scientific stage and not directly usable by MSP management bodies. While spatial management tools are well established in fisheries management, these often still work on scales that may be too coarse for a MSP that has to include also small-scale-uses and aims for multi-use concepts. On the other hand the given examples point out a number of issues that underline the need for integration of fisheries in MSP.

Introduction, Materials, and Methods

Fisheries and Marine Spatial Planning (MSP) still have a widely unsettled relationship. While several scientific studies highlight the strong relation between fisheries and MSP as well as ways how fisheries could be included in MSP, the actual integration of fisheries in MSP often fails. In the present study we review the state of the art and the progress achieved by more than a dozen studies on ways towards integration of fisheries and MSP. The reviewed studies address a wide range of integration challenges from the MSP stocking phase and the MSP draft plan development and negotiation phase, starting with technics to analyse where fishermen actually fish, studies on the drivers for fishermen's behaviour, seasonal dynamics and long-term spatial changes of commercial fish species under various anthropogenic pressures along their successive life stages, the effects of spatial competition on fisheries and projections on those spaces which might become important fishing areas in future up to studies on how fisheries could benefit from MSP. Given is an overview about latest developments on concepts, tools, and methods. It becomes apparent that spatial and temporal dynamics of fish and fisheries as well as the definition of spatial preferences remain to be major challenges, but that already today an integration of fisheries is possible while often MSP processes do not exhaust these possibilities yet.

Results and Discussion

General information on spatial needs of fisheries, on drivers for fishers' behaviour, and on impacts of competing human uses is available for many European seas. A wide array of tools and methods to

identify productive areas with relevance for fish resources, fisheries and the management of fish stocks (e.g. fishing grounds, spawning grounds, nursery grounds, benthic habitats, etc.) are available or under development (e.g. VMS data analysis; assessments on the spatial dynamics of commercially important fish species during different life stages). The same is true for models that support analyses on changes in species distribution and of effects of MSP or human uses on existing fisheries (e.g. assessments on long-term changes in fish species distributions due to climate change; fleet models like FishRent and DISPLACE, partly including comprehensive extensions to assess the effect of competing human activities including bio-economic modelling; discrete-choice models for the assessment of effects of competing maritime human uses on fisheries; spatio-temporally varying management strategies; and analyses on the potential benefit of MSP for fisheries). A comprehsive overview is given in Janßen et al. (subm.). However, the reviewed papers, approaches and case studies highlighted that very often these tools, methods and models are still in a scientific stage and not directly usable by MSP management bodies (e.g. still require fine scaled data, advanced modelling skills, computer intensive facilities, and fast-enough sensitivity analyses). Nonetheless, the given examples point out a number of issues that underline the need for integration of fisheries in MSP.

Space is not equally important to fish stocks and fisheries. What sounds like a platitude for a fisheries biologist is a challenge for MSP. Very often MSP processes miss to identify those areas which are of increased relevance for fisheries or for fish species during different life stages. The spatial resolution of today's fisheries science tools might often be relatively coarse compared to other MSP data. But these tools are able to provide MSP decision makers with information about areas that are valuable or less valuable for fish, fisheries and fisheries management already today. Nonetheless, there is a need for improvement. Stock dynamics and fleet movements operate at fine spatial scale while the catches and fishing effort are usually reported at the ICES rectangle scale which does describe well enough the space and time structure and changes in stock and fleet distribution (nursery areas, spawning areas, economic zones, ports and vessel mobility, etc.). Improvement, e.g. on the basis of VMS tracks, is under way.

How to define valuable areas? Fisheries is often mainly understood as an economic sector. In these cases areas valuable for fisheries are often defined as those areas with high fishing effort, high catches, or high revenues. These methods usually work fine but they partly ignore the broader approach of spatial planning as defined within the European Regional/Spatial Planning Charter according to which 'spatial planning gives geographical expression to the economic, social, cultural and ecological policies of society'. Especially the integration of social and cultural dimensions may require additional criteria for the definition of valuable areas.

MSP's responsibility for fisheries and fish stocks. Independent from a countries MSP philosophy, MSP may affect fisheries and fish stocks on various levels. MSP assigns spaces to human uses which usually cause limitations of fisheries with effects on effort, fleet behaviour, and revenues. MSP may also have direct and indirect influence on the development of fish stocks. Within Europe, Article 5 of the EU MSP Framework Directive (Directive 2014/89/EU) obliges member states to implement MSP with the objective of achieving a sustainable development of the fisheries sector. MSP could be especially efficient to prevent new alteration of spawning grounds by managing human activities. Though MSP is not the only instrument for spatial fisheries management, it clearly has a responsibility for fisheries and should assume this responsibility. Reconsidering the global scale of fisheries it will be important that a better integration of fisheries in MSP succeeds in various parts of the world.

References

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